$$\mathrm{Out}_{\mathrm{new}} = \begin{cases} 1, \text{ if } (U(M) > G_1 \ \Delta \quad \mathrm{Out}_{\mathrm{old}} = 0) \\ 0, \text{ if } (U(M) < G_2 \ \Delta \quad \mathrm{Out}_{\mathrm{old}} = 1) \end{cases} \qquad (1)$$

Sensor systems with freely programmable algorithms

Besides sensor units in which the sensor signal is processed in accordance with fixed algorithms, there are types in which the processing algorithm can be freely programmed by fixed prescribed parameters. These fixed prescribed parameters are stored for example, in EEPROM cells, which are situated on the same chip as the other components of the sensor unit (e.g., the sensor element and the sensor-signal processing unit). An example of this is the analog sensor of the construction series HAL800 manufactured by Micronas GmbH, the assignee of the present invention. Its analog output signal can be programmed in the parameters C_1 and C_2 as

$$\mathrm{Out} = c_1 * U(M) + c_2 \qquad (2)$$

Its advantage compared to the sensor systems with fixed signal processing algorithms is that the programming can reduce production-based variations and influences due to the interactions of the sensor system with its action.

Once the programming process is concluded, the sensor unit behaves like a sensor unit with a fixed signal processing algorithm as discussed above. Accordingly, the sensor unit has fixed settings by which the measurement variable M is converted into an output signal Out. However, a problem with this technique is that the programming adjustments can no longer be changed, that is, this state is technically called "locked."

Sensor units with control algorithms

In a third class of sensor units, the sensor-signal processing unit operates with internal regulation algorithms. Such regulation algorithms convert a time-variable, analog, internal voltage signal U(M,t) into an output signal Out. The time dependence of the internal voltage signal U(M) is identified by the reference symbol t.

For example, there exist adaptive magnetic field sensors in which the internal voltage signal U(M) is subjected to high-pass filtering. Specifically, the DC component of the internal voltage signal U(M) is attenuated, and in the ideal case only a sinusoidal alternating signal $U(M_{AC})$ remains. If this remaining sinusoidal alternating signal exceeds a given threshold G_1, then – as in the example described above – an output state Out = "1" is generated. However, if the AC component is less than a second threshold G_2, the output signal Out = "0" is generated. The mathematical representation of such a generation of the output signal is given by equation (3) as follows:

$$U(M_{AC}) \Rightarrow U(M) - \int_{t_1}^{t_2} U(M)dt$$

$$Out_{new} = \begin{cases} 1, \text{ if } (U(M_{AC}) > G_1 \quad \Delta \quad Out_{old} = 0) \\ 0, \text{ if } (U(M_{AC}) < G_2 \quad \Delta \quad Out_{old} = 1) \end{cases} \qquad (3)$$

Sensors of this type, in contrast to the previous two types discussed above, also take into account the time behavior of the measurement variable M.

Sensors with programmable regulation algorithms

This fourth class of sensor units is a combination of the type with freely programmable algorithms and the type with control algorithms. Sensors of type with programmable regulation algorithms consequently combine the advantages of a sensor unit of type with freely programmable algorithms and of a sensor unit of type with control algorithms. Since signal processing is freely programmable, one can compensate the tolerances of a total system, consisting of mechanical components and the actual sensor system. However, as the result of regulation, the output signal Out will react to the instantaneous time behavior of the measurement variable M(t). Conventional sensor systems preferably operate by the latter method. However, a problem with this technique is that changes of the sensor system are no longer compensated, especially of the sensor element, within the lifetime of the sensor unit,

Therefore, there is a need for a sensor that can be programmed to compensate for changes in the sensor system that occur throughout the operating life of the sensor.

SUMMARY OF THE INVENTION

Briefly, according to an aspect of the present invention, a sensor system includes a sensor signal processing unit and an analytical unit. The analytical unit is designed in such a way that at least one parameter for signal processing can be redefined on the basis of the output signals delivered by the sensor processing unit. At least one connecting line between a sensor-signal processing unit and the analytical unit establishes a connection for transmitting at least one of the newly defined parameters for processing the sensor signal to the sensor-signal processing unit. The sensor-signal processing unit is inventively designed in such a way that the newly